

PROVISIONAL SUNSPOT RELATIVE NUMBERS FOR NOVEMBER 1939

[Dependent alone on observations at Zurich]

Data furnished through the courtesy of Prof. W. Brunner, Eidgen, Sternwarte, Zurich, Switzerland]

November 1939	Relative numbers	November 1939	Relative numbers	November 1939	Relative numbers	November 1939	Relative numbers	November 1939	Relative numbers	November 1939	Relative numbers
1-----	a --	11-----	Eac --	21-----	d 67	9-----	Ec 40	19-----	Mc 75	29-----	a 43
2-----	Eac? --	12-----	82	22-----	*a 65	10-----	Mc 46	20-----	50	30-----	43
3-----	72	13-----	--	23-----	62						
4-----	61	14-----	Eac 98	24-----	Ec 61						
5-----	a 58	15-----	a 87	25-----	58						
6-----	62	16-----	d 111	26-----	--						
7-----	a 66	17-----	--	27-----	Mac 62						
8-----	Ec 37	18-----	b 103	28-----	61						

Mean, 24 days=65.4.

a=Passage of an average-sized group through the central meridian.

b=Passage of a large group through the central meridian.

c=New formation of a group developing into a middle-sized or large center of activity; E, on the eastern part of the sun's disk; W, on the western part; M, on the central-circle zone.

d=Entrance of a large or average-sized center of activity on the east limb.

*=Chur.

AEROLOGICAL OBSERVATIONS

[Aerological Division, D. M. LITTLE in charge]

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During November 982 radiosonde and airplane observations were made in the United States, Alaska, Canal Zone, Hawaii, and the West Indies. Of these, 819 were radiosondes, with 96, 88, 71, and 36 percent reaching 5, 10, 15, and 18 kilometers, respectively. Tables 1 and 1a show these observations, while pressures, temperatures, and resultant winds for 5,000 feet (1.5 kilometers), 3, 4, and 5 kilometers, are shown on charts VIII, IX, X and XI, respectively. Chart XII gives the isentropic data for November; tables 2 and 3 list the winds; and table 4 indicates the tropopauses. Effective November 15, 1939, the hour of all radiosonde observations was advanced to 1 a. m., 75th meridian time.

The mean free-air pressures at 5,000 feet (chart VIII) were lowest over the northeastern United States (Mount Washington, N. H., 840 millibars), the northern Great Lakes region (Sault Ste. Marie, Mich., 845 millibars), and thence northeastward over Canada (Newfoundland, 833 millibars). Pressure was lowest, however, in Alaska (Fairbanks and Juneau, 825 and 832 millibars, respectively). Mean pressures were relatively low along the Pacific coast, but the highest occurred over the central Rocky Mountain region, the South, and the Southeast (Durango, Colo., San Antonio, Tex., and Pensacola, Fla., 855 millibars).

At 3 kilometers (chart IX) the distribution showed a statistical low over Sault Ste. Marie, Mich., (699 millibars), and a high over Pensacola, Fla. (714 millibars). Mean pressure continued relatively lower over the Pacific slope, but again the lowest pressure of the month occurred over Alaska (Fairbanks, 678 millibars).

Charts X and XI show the mean pressures at 4 and 5 kilometers, respectively. In the United States the lowest pressure persisted over Sault Ste. Marie, Mich., while the southern high-pressure area became definitely centered over Miami, Fla. Low pressure continued over Alaska, with Fairbanks having the lowest during November (592 and 514 millibars at 4 and 5 kilometers, respectively).

Above 5 kilometers the lowest pressures for the country were located over Sault Ste. Marie, Mich.; the pressures at Buffalo, N. Y., being only slightly higher. However, the lowest pressures noted during the month still persisted over the Alaskan stations, where Fairbanks was consistently lower than Juneau at all levels (decreasing steadily from a difference of 11 millibars less at 6 kilometers to 3 millibars less at 15 kilometers). The highest pressure in all upper levels prevailed at Miami, Fla., although relatively high pressures were found over the Southwest.

In the lower levels November mean free-air pressures were higher than during the preceding month. Maximum differences were noted at the surface, but these decreased slowly with altitude until no differences between the 2 months existed at 1.5 and 2 kilometers over the East and Southeast; at 2.5, 3, and 4 kilometers over the South, Southwest and Pacific States; and from 6 to 11 kilometers over the northern Rocky Mountain region. Above these levels the November pressures were lower than during the preceding month. This situation was particularly outstanding at 8, 9, 10, and 11 kilometers, where, in several instances, the current month was as much as 10 millibars lower. Above these levels the pressure differences decreased with altitude until the November pressure was from 1 to 2 millibars less than during October.

At stations where radiosonde observations have been conducted for a full year a comparison of November pressures with those recorded in the corresponding month of 1938 showed that consistently higher pressures prevailed during the current month at all levels over Omaha, Nebr., and Bismarck, N. Dak., (the latter being compared with Fargo, N. Dak.) But Nashville, Tenn., Oakland, Calif., Oklahoma City, Okla., and Sault Ste. Marie, Mich., showed current pressures to be higher at all levels up to 4, 5, 6, and 9 kilometers, respectively, and lower than in 1938 at all levels above. At Washington, D. C., the current year and month showed lower pressures above 2 kilometers.

Mean relative humidity for November was generally high in the lower levels and, in some cases, continued into the upper levels. High humidity at all levels was noted over Sault Ste. Marie, Mich., Washington, D. C., Miami, Fla., Buffalo, N. Y., and Shreveport, La., while relative humidities were lowest over Oakland, Calif., San Diego, Calif., Bismarck, N. Dak., Medford, Oreg., and Oklahoma City, Okla. Juneau, Alaska, recorded the greatest percentage of mean relative humidities at all levels.

In the United States the temperatures at 1.5 kilometers (chart VIII) were lowest over Sault Ste. Marie, Mich., and highest over Miami, Fla., and San Diego, Calif. At this level the temperature over all of the country, except the Great Lakes region and New England, was above freezing (0° C.). However, at Fairbanks and Juneau, Alaska, the lowest temperatures were recorded (-12.6° C. and -4.5° C., respectively). Similar conditions prevailed at 3, 4, and 5 kilometers (charts IX, X, and XI, respectively), with the exception that Miami, Fla., became considerably warmer than San Diego, Calif., and freezing temperatures spread farther over the South.

Above 5 kilometers temperatures in the United States were lowest over Sault Ste. Marie, Mich., and highest over Miami, Fla. However, at 13 kilometers, both El Paso, Tex., and San Antonio, Tex., became colder than Sault Ste. Marie, Mich., while at 14 kilometers Miami, Fla., became colder than any station and continued so to the maximum altitude reached. The lowest mean temperature recorded during November (-72.3°C.) occurred at 17 kilometers over Miami, Fla. Both Alaskan stations became warmer than elsewhere at 12 kilometers and remained so throughout all higher levels.

Individual minimum temperatures were lowest over the southern stations (Miami, Fla., -77.8°C. ; Charleston, S. C., -75.2°C. ; El Paso, Tex., -74.3°C. ; Atlanta, Ga., -74.2°C. ; and San Antonio, Tex., -73.0°C.). All stations south of the 35th parallel, as well as Nashville, Tenn., and Oakland, Calif., recorded individual low temperatures colder than -70.0°C. The warmest minimum temperatures occurred over the Alaskan stations (Fairbanks and Juneau, -60.8°C.). Lowest temperatures recorded over Fairbanks, Alas., occurred at 9 kilometers; over Sault Ste. Marie, Mich., at 13 kilometers; and over St. Louis, Mo., Atlanta, Ga., and Miami, Fla., at 16 kilometers. Mean freezing temperatures (0°C.) occurred north of the Great Lakes area at the surface; as far south as Pennsylvania, lower Michigan, and Minnesota at the 1-kilometer level; over Maryland, the Ohio valley, Iowa, and North Dakota at 2 kilometers; over Georgia, Oklahoma, Wyoming, and Oregon at 3 kilometers; and over southern Florida at 4 kilometers.

In the United States and Alaska all radiosonde stations had lower temperatures during November than in the preceding month at all levels up to about 14 kilometers, and then warmer above. However, Billings, Mont., Bismarck, N. Dak., Joilet, Ill., Miami, Fla., Minneapolis, Minn., Phoenix, Ariz., and Sault Ste. Marie, Mich., were colder during the current month at all levels. At those stations where radiosonde observations have been made for a year the current month was colder than November 1938, at all levels over Nashville, Tenn., Sault Ste. Marie, Mich., and Washington, D. C. But Bismarck, N. Dak., and Oakland, Calif., were warmer than 1938 at all levels, while Oklahoma City, Okla., and Omaha, Nebr., were warmer only in the lower levels, and then colder above.

Considering the season of the year November pilot-balloon observations were quite satisfactory as high maximum altitudes were reached in many cases, and at all Weather Bureau stations in the United States balloon flights exceeded 5 kilometers. At 64, 23, 5, and 3 stations individual maximum altitudes in excess of 10, 15, 20, and 25 kilometers, respectively, were reached. Western stations, as well as those in the Southeast, reached altitudes higher than 10 kilometers. Most maximum elevations were reported on the 3d, 13th, 14th, and 28th of November.

The pilot-balloon work previously conducted at Cleveland, Ohio, was transferred to Akron, Ohio, beginning with November 1, 1939. Also, effective November 15, the hour of all pilot-balloon observations was changed to 5 a. m., 11 a. m., 5 p. m., and 11 p. m., 75th meridian time.

Resultant-wind directions and forces, based on 5 a. m., 75th meridian time observations made at 1.5 kilometers during November, are shown on chart VIII. Over the eastern two-thirds of the country the winds were from the northwest quadrant, but in the far West the directions were generally from the southwest. During the current month the wind directions were more northerly than in the preceding month, except in the far West and North-

west. Resultant velocities were moderate; the highest being confined to the East (Harrisburg, Pa., 10.7 meters per second). Low velocities occurred over the South, California and western Nevada (Sacramento, Calif., 0.1 meters per second).

At 1.5 kilometers the current winds departed from normal directions by turning northward in clockwise rotations over the eastern and southern portions of the United States. But in the northwestern portion of the country the winds backed away from normal by turning in counterclockwise rotations so as to become more southerly than normal. Large clockwise departures occurred over Houston, Tex., Nashville, Tenn., Sault Ste. Marie, Mich., and San Diego, Calif. Resultant velocities were lighter than normal over most of the country, except in the far Northwest and the extreme East. Outstanding velocity departures were found over Seattle, Wash., where the current resultant was greater than normal ($+4.5$ meters per second), and at Nashville, Tenn., where it was lower (-4.8 meters per second).

The winds at 3 kilometers (chart IX) showed that northwesterly resultants predominated. However, along the Pacific coast the directions were westerly and southwesterly. The current directions were more northerly than those observed during October, except in the far Northwest where the November directions were more southerly. Resultant velocities for November were lowest in the far Southwest and over California. But elsewhere the wind velocities were higher than those noted at 1.5 kilometers. The highest velocity in November at 3 kilometers occurred over Richmond, Va., (11.3 meters per second).

November directions at the 3-kilometer level showed departures from normal that turned through clockwise rotations over all of the United States, except in the far Northwest. Large departures from normal occurred over Oklahoma City, Okla., San Diego, Calif., Medford, Oreg., and Spokane, Wash. The velocities were less than normal over the entire country, with the exception of the extreme Northwest. Outstanding negative departures from normal were noted over Albuquerque, N. Mex. (-5.0 meters per second), Cheyenne, Wyo. (-5.3 meters per second), Omaha, Nebr. (-4.1 meters per second), Nashville, Tenn. (-4.6 meters per second), and Boston, Mass. (-4.2 meters per second).

Chart X shows the resultant winds at 4 kilometers, based on 5 p. m., 75th meridian time observations. Northwesterly directions again predominated over most of the country. While winds from the southwest quadrant persisted in the northern portion of the Pacific slope, northwesterly and northerly winds occurred over all but extreme southern California. Resultant velocities at 4 kilometers were unusually low in the extreme Southwest, and a resultant calm occurred at Winslow, Ariz. The highest velocities were noted over the Eastern States (Richmond, Va., 15.9 meters per second), and the Ohio Valley and lower Great Lakes region (Chicago, Ill., 14.2 meters per second).

At 4 kilometers the winds were more northerly than normal over the eastern half of the country, and more southerly over the western portion. Departures from normal were outstanding at Boston, Mass., Nashville, Tenn., Medford, Oreg., Seattle, Wash., Salt Lake City, Utah, and Spokane, Wash. Current resultant velocities were greater than normal over the eastern one-third of the United States and the far Northwest, but less than normal elsewhere (Chicago, Ill., $+4.0$ meters per second; Cincinnati, Ohio, $+3.9$ meters per second; Seattle, Wash., $+3.0$ meters per second; Cheyenne, Wyo., -3.7 meters

per second; and Salt Lake City, Utah, -4.6 meters per second).

Resultant-wind directions at 5 kilometers were northwesterly in practically all cases, except the extreme Southeast and far Northwest. Velocities were high east of the Mississippi Valley, being above 10 meters per second, in all but two cases. Richmond, Va., reported the highest velocity (18.2 meters per second). Low resultant velocities persisted, however, in the extreme Southwest, being only 0.3 meter per second at Winslow, Ariz.

The November wind directions at 5 kilometers departed from normal by backing in counterclockwise rotations over the Southeast and the Pacific coast. Elsewhere the wind directions departed from normal in clockwise rotations. Outstanding departures were noted at Spokane, Wash., Medford, Oreg., and Oakland, Calif. Extreme departures from the normal velocities were noted over Houston, Tex. (+4.4 meters per second), Medford, Oreg. (-3.0 meters per second), Albuquerque, N. Mex. (-5.4 meters per second), and Salt Lake City, Utah (-4.4 meters per second).

A study of wind directions and velocities at 1.5 kilometers, based on 5 a. m. (chart VIII) and 5 p. m. (table 2) observations, indicated a diurnal change in the afternoon directions from those noted at 5 a. m. This departure was clockwise over the South and Southeast, and the central and southern Pacific and Rocky Mountain areas, and counterclockwise elsewhere over the country. At Abilene, Tex., Atlanta, Ga., Little Rock, Ark., and Salt Lake City, Utah, the 5 p. m. winds were more northerly than at 5 a. m. by wide variations, but at Reno, Nev., Sault Ste. Marie, Mich., and Brownsville, Tex., they were decidedly more southerly. Afternoon velocities were higher in the extreme southwest and Southeast, and along the northern border; elsewhere they were lower, particularly the Ohio valley (Cincinnati, Ohio, -2.9 meters per second).

At 3 kilometers the 5 p. m. winds were more southerly than at 5 a. m. over most of the country with the exception of the Northeast and the Great Lakes region, the far Northwest and the extreme Southeast. The afternoon resultant velocities were higher than at 5 a. m. east of a line from El Paso, Tex., to Fargo, N. Dak., and lighter

elsewhere. High velocity excesses in the afternoon over the 5 a. m. wind speeds occurred at Washington, D. C. (+3.7 meters per second), Nashville, Tenn. (+3.1 meters per second), and Omaha, Nebr. (+3.6 meters per second).

Table 2 lists resultant winds based on 5 p. m., 75th meridian time observations. Pilot-balloon flights in the East and Southeast show that the winds turned in counterclockwise rotations as the altitude increased. This was outstanding at Atlanta, Ga., and Charleston, S. C. Over the remainder of the United States the winds turned generally toward the north in clockwise rotations with altitude, particularly over the Great Lakes region and the Northwest. Elsewhere it was noted that as an altitude of 10 kilometers was gained the winds ceased to turn clockwise and began gradually to back in a counterclockwise rotation. At this level the maximum 5 p. m. resultant velocities were noted, and the greatest pressure gradient (by radiosonde observations) between the low- and high-pressure areas (Sault Ste. Marie, Mich., and Miami, Fla., with a gradient difference of 26 millibars) was found to occur.

Table 3 shows the maximum individual wind speeds observed during November. While the velocities were not unusually excessive, the speeds of 45.7 meters per second over Harrisburg, Pa., at 2,360 meters, and 75.2 meters per second over Abilene, Tex., were high for these stations.

MONTHLY MEAN ISENTROPIC CHART ¹

The mean isentropic chart, $\theta=302^\circ$ (chart XII), for November 1939 is characterized by two weak anticyclonic eddies over the Southwest, both evidently off-shoots of the broad west-northwesterly current over the eastern half of the country. This strong current, which seems also to have a weak downslope motion, has effectively blocked the transport of moisture from the Gulf of Mexico, and is undoubtedly the cause of the almost general deficit in precipitation in the East. The large deficit in the Northwest, on the other hand, is located in a region of upslope motion; however, the air is unusually dry and probably this circumstance was the decisive factor in decreasing the precipitation.

¹ Prepared by the Division of Research and Education.

TABLE 1.—Mean free-air barometric pressures (P.) in mb., temperatures (T.) in ° C., and relative humidities (R. H.) in percent obtained by airplanes ¹ during November 1939

Stations and elevations in meters above sea level	Altitude (meters) m. s. l.																											
	Number of obs.	Surface			500			1,000			1,500			2,000			2,500			3,000			4,000			5,000		
		P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.
Coco Solo, C. Z. (15 m).....	16	1,010	25.4	90	956	24.1	86	903	21.7	84	852	19.1	81	804	16.7	73	759	14.7	65	715	12.6	57	634	7.0	50	-----	-----	-----
Norfolk, Va. (10 m).....	25	1,025	6.9	74	966	8.2	63	909	5.8	60	855	3.9	57	804	2.1	53	756	3	50	709	-2.6	48	625	-10.0	47	548	-17.5	48
Pearl Harbor, T. H. (6 m).....	30	1,015	21.7	81	960	19.7	76	905	15.9	81	854	13.0	77	804	12.2	57	757	10.4	39	713	7.9	34	631	1.7	27	-----	-----	-----
Pensacola, Fla. (13 m).....	27	1,024	9.4	80	968	13.3	61	910	11.3	59	857	9.2	58	807	7.9	48	759	6.1	44	714	3.7	41	630	-2.4	46	555	-8.5	44
St. Thomas, V. I. (8 m).....	16	1,014	27.0	78	959	23.7	92	906	20.9	85	854	18.5	74	805	16.4	66	759	13.9	67	716	11.5	61	634	6.1	61	-----	-----	-----
San Diego, Calif. (10 m).....	28	1,015	15.0	75	959	17.5	66	904	16.5	40	852	13.5	36	803	10.4	33	755	7.2	30	710	4.3	27	628	-3.0	24	-----	-----	-----
Seattle, Wash. (10 m).....	21	1,019	9.2	82	962	10.2	63	906	8.9	60	852	6.3	60	802	3.7	56	754	1.3	48	708	-0.9	40	624	-5.9	48	-----	-----	-----

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St. Thomas, V. I. (8 m).....	29	1,013	27.8	77	958	24.4	91	905	21.7	84	854	19.0	78	806	16.8	71	759	14.4	66	715	11.7	66	635	6.4	56	-----	-----	-----
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¹ U. S. Navy

Observations taken about 1 a. m. 75th meridian time, except by Navy station along the Pacific coast and Hawaii where they are taken at dawn.

NOTE.—None of the means included in this table are based on less than 15 surface or 5 standard-level observations.

TABLE 1a.—Mean free-air barometric pressures (P.) in mb., temperatures (T.) in ° C., and relative humidities (R. H.) in percent obtained by radiosondes during November 1939

Altitude (meters) m. s. l.	Stations and elevations in meters above sea level																											
	Albuquerque, N. Mex. (1,621 m.)				Atlanta, Ga. (298 m.)				Shreveport, La. ¹ (51 m.)				Billings, Mont. (1,089 m.)				Bismarck, N. Dak. (508 m.)				Boise, Idaho (824 m.)				Buffalo, N. Y. (219 m.)			
	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.
Surface-----	30	843	5.3	53	30	988	6.3	78	22	1,018	8.5	84	30	896	3.9	44	30	961	-1.8	70	30	928	-0.3	86	30	997	1.3	77
500-----					30	965	8.7	73	22	965	10.3	75									29	963	0.4	73	29	963	0.4	73
1,000-----					30	908	7.5	68	22	910	8.9	77					30	905	4.8	54	30	908	5.0	71	29	904	-1.7	71
1,500-----					30	854	5.6	62	22	856	7.3	75	30	852	8.5	41	30	851	3.3	48	30	854	6.2	55	29	849	-2.6	61
2,000-----	30	805	6.6	51	30	803	3.2	55	21	805	5.9	67	30	802	6.3	39	30	800	2.0	43	30	803	4.0	51	29	796	-3.9	54
2,500-----	29	757	3.7	52	30	755	0.8	52	21	757	4.0	64	30	754	2.8	38	30	751	-0.2	38	30	755	1.5	45	29	747	-5.9	50
3,000-----	29	712	0.8	50	30	709	-1.7	48	19	712	2.3	61	30	708	-0.6	38	29	705	-2.7	34	30	709	-1.6	43	29	701	-8.3	50
4,000-----	29	628	-4.1	44	30	625	-7.0	42	18	630	-1.9	56	30	624	-6.6	38	29	621	-9.0	31	30	625	-7.6	43	29	615	-14.1	50
5,000-----	29	552	-10.7	40	30	549	-12.9	44	17	554	-7.4	52	30	549	-13.3	38	29	545	-15.5	29	30	549	-13.8	42	27	538	-20.2	46
6,000-----	29	494	-18.6	39	29	481	-19.4	43	15	485	-13.0	50	30	480	-20.6	38	29	476	-22.6	27	30	480	-21.5	41	27	470	-27.6	45
7,000-----	29	422	-26.4	38	29	420	-26.9	42	11	425	-19.7	52	30	419	-28.5	38	28	414	-31.0	27	30	418	-29.8	40	27	408	-35.3	44
8,000-----	30	367	-34.4	37	29	365	-34.5	43	9	371	-25.5	51	30	363	-37.0	37	28	359	-39.0	28	30	363	-38.0	40	26	352	-42.2	
9,000-----	30	317	-42.1	35	29	315	-41.1		6	324	-32.2	48	30	314	-45.3		28	309	-46.8		30	313	-45.8	40	27	303	-48.8	
10,000-----	30	273	-48.8		29	272	-47.5						30	269	-52.5		28	265	-53.4		30	269	-53.2		27	260	-54.4	
11,000-----	29	234	-53.8		29	233	-53.0						30	230	-58.6		27	227	-58.1		30	230	-58.9		27	222	-56.8	
12,000-----	28	200	-57.5		29	199	-57.3						30	196	-61.4		27	193	-60.2		30	196	-61.4		27	189	-58.1	
13,000-----	27	171	-60.2		29	170	-61.1						30	167	-61.3		26	164	-60.0		30	167	-62.5		25	161	-59.2	
14,000-----	25	145	-62.6		29	144	-63.9						30	142	-60.9		24	140	-60.1		29	142	-62.4		23	137	-60.3	
15,000-----	25	123	-64.2		27	123	-66.2						30	121	-61.5		23	119	-60.4		29	120	-62.9		22	116	-61.6	
16,000-----	25	104	-65.4		27	104	-67.9						26	103	-61.3		21	102	-59.8		29	102	-62.6		21	99	-61.9	
17,000-----	18	89	-65.5		25	88	-67.7						24	88	-61.0		18	86	-59.1		27	87	-62.0		17	84	-61.8	
18,000-----	10	76	-65.0		19	75	-66.1						14	75	-60.4		11	74	-57.9		23	74	-61.0		17	71	-61.8	
19,000-----					7	63	-63.9						8	63	-59.8						19	63	-59.6					
20,000-----																					7	54	-58.7					

Stations and elevations in meters above sea level																												
Altitude (meters) m. s. l.	Charleston, S. C. (14 m.)				Denver, Colo. (1616 m.)				El Paso, Tex. (1194 m.)				Ely Nev. (1909 m.)				Fairbanks, Alaska (152 m.)				Joliet, Ill. (178 m.)				Juneau, Alaska (49 m.)			
	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.
Surface.....	30	1,021	6.5	86	30	843	0.1	60	30	887	7.4	65	30	814	-1.9	61	29	987	-17.7	68	29	1,003	1.0	87	30	1,000	3.6	82
500.....	30	963	10.6	63													29	944	-16.6	72	29	964	3.2	69	30	946	1.7	82
1,000.....	30	907	9.0	57													29	883	-13.8	72	29	906	1.6	62	30	889	-1.6	84
1,500.....	30	854	7.0	55													29	827	-12.6	70	29	852	0.3	55	30	834	-4.5	85
2,000.....	30	803	5.3	49	30	804	6.2	52	30	856	9.3	59					29	774	-13.3	68	29	799	-2.1	52	29	783	-7.2	84
2,500.....	30	755	3.0	45	30	757	4.4	46	30	757	4.2	60	30	757	4.0	47	29	725	-16.0	66	29	750	-4.5	50	29	734	-10.2	82
3,000.....	30	710	0.5	40	30	711	1.1	44	30	712	1.7	60	30	711	1.3	44	29	678	-18.8	63	29	704	-6.9	49	28	687	-13.2	79
4,000.....	29	626	-4.8	34	30	627	-5.4	43	30	628	-3.6	52	30	627	-5.1	41	29	692	-25.5	63	29	619	-12.2	45	24	601	-19.5	76
5,000.....	29	551	-19.6	33	30	552	-11.8	44	30	553	-10.0	44	29	552	-11.6	35	27	514	-32.6	60	29	542	-18.6	41	21	525	-26.3	73
6,000.....	29	483	-17.3	33	30	483	-10.3	42	30	485	-17.2	40	28	483	-19.0	32	27	445	-39.8	58	29	473	-25.9	39	19	456	-33.9	73
7,000.....	29	422	-24.0	33	30	422	-27.0	41	30	368	-31.8	36	26	422	-27.1	32	27	384	-47.0	32	29	411	-33.7	39	15	394	-41.5	
8,000.....	29	366	-31.6	32	30	366	-35.1	40	30	319	-38.9	36	26	366	-35.6	32	27	329	-52.7		29	356	-40.9		13	339	-48.2	
9,000.....	29	318	-38.7	32	30	316	-43.5		30	272	-50.8		26	316	-43.5		27	282	-55.1		29	306	-47.8		12	290	-52.5	
10,000.....	29	274	-45.3		30	272	-50.8		30	236	-53.0		26	272	-51.1		25	241	-53.3		28	262	-53.0		11	243	-53.3	
11,000.....	28	235	-51.3		29	233	-56.2		30	202	-58.4		26	233	-57.1		24	207	-51.3		28	225	-55.7		9	213	-51.2	
12,000.....	27	202	-56.2		28	199	-59.2		30	172	-61.4		25	198	-60.2		24	177	-60.7		26	192	-57.4		7	182	-49.8	
13,000.....	26	172	-60.4		28	169	-60.9		29	146	-64.4		25	169	-61.1		22	151	-50.9		25	164	-58.5		7	156	-49.6	
14,000.....	24	146	-63.8		26	144	-61.7		29	146	-64.4		23	144	-61.6		20	130	-51.0		24	139	-60.0		7	134	-49.7	
15,000.....	23	124	-66.6		26	123	-62.7		28	124	-67.0		22	122	-62.8		15	112	-51.0		20	118	-60.8		6	115	-49.6	
16,000.....	21	105	-68.3		24	104	-63.5		28	105	-68.4		21	104	-63.5		13	95	-61.0		18	101	-61.2					
17,000.....	16	89	-68.7		20	89	-63.2		25	89	-68.4		16	88	-63.2		8	81	-51.1		14	89	-61.0					
18,000.....	14	75	-66.8		15	76	-62.7		22	75	-66.4		11	75	-62.4						6	73	-60.9					
19,000.....	11	64	-65.2						12	64	-65.2																	
20,000.....	7	54	-63.0																									

Stations and elevations in meters above sea level																												
Altitude (meters) m. s. l.	Lakehurst, N. J. ¹ (39 m.)				Medford, Oreg. (401 m.)				Miami, Fla. (4 m.)				Minneapolis, Minn. (263 m.)				Nashville, Tenn. (180 m.)				Oakland, Calif. (2 m.)				Oklahoma City, Okla. (391 m.)			
	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.
Surface.....	28	1,017	2.6	73	29	974	4.4	83	29	1,017	18.2	87	30	992	0.6	70	29	1,003	4.2	78	29	1,019	8.9	82	30	979	6.6	71
500.....	28	961	2.3	61	29	962	5.9	78	29	961	18.1	77	30	963	3.0	66	29	965	6.4	68	29	960	13.7	58	30	965	8.1	69
1,000.....	28	904	0.5	62	29	905	9.2	56	29	906	15.0	78	30	906	2.4	59	29	908	4.6	62	29	905	12.8	44	30	909	7.3	56
1,500.....	27	849	-0.2	55	29	852	8.4	48	29	854	12.2	73	30	851	0.6	52	29	854	3.2	55	29	853	10.5	36	30	855	5.3	56
2,000.....	27	798	-1.7	54	29	802	5.6	47	29	804	11.0	65	30	800	-1.5	48	29	802	1.3	50	29	803	8.4	31	30	804	3.1	57
2,500.....	27	749	-3.2	55	29	754	3.0	42	29	757	9.5	54	30	751	-4.2	49	29	754	-0.8	49	29	755	5.8	28	30	766	1.6	47
3,000.....	27	703	-5.8	54	29	708	0.6	37	29	713	7.2	45	30	704	-6.3	47	29	708	-3.4	49	29	710	2.8	25	30	710	-0.5	44
4,000.....	27	618	-10.9	59	29	625	-5.9	36	29	631	2.0	39	30	619	-11.7	46	29	623	-8.9	48	29	627	-3.7	25	30	628	-6.1	46
5,000.....	27	542	-17.0	63	29	549	-12.1	33	29	557	-3.9	33	30	543	-18.1	45	28	547	-15.0	47	29	551	-10.3	24	29	550	-12.2	36
6,000.....	26	473	-23.9	67	29	481	-10.9	32	29	490	-9.5	34	30	474	-25.5	44	28	478	-21.4	44	29	483	-17.5	23	28	481	-10.0	34
7,000.....	26	411	-31.2	66	28	420	-27.3	32	29	430	-15.7	32	30	412	-33.6	43	27	362	-35.7	42	29	367	-33.9	22	28	365	-34.0	34
8,000.....	23	357	-39.1	1	28	364	-35.5	31	29	376	-22.7	31	30	356	-41.5	26	313	-42.5	5	29	317	-42.2	22	28	315	-41.8	—	—
9,000.....	22	308	-46.2	2	28	314	-43.2	—	29	327	-30.5	30	30	307	-48.6	26	269	-48.2	—	29	273	-50.1	—	28	271	-49.0	—	—
10,000.....	20	264	-51.6	2	28	270	-51.0	—	28	284	-38.2	28	30	263	-54.2	25	231	-52.6	—	29	234	-56.8	—	28	232	-54.4	—	—
11,000.....	17	226	-54.9	—	27	231	-57.7	—	27	210	-53.0	—	29	192	-58.7	20	198	-56.5	—	29	199	-60.8	—	28	198	-58.5	—	—
12,000.....	16	193	-56.7	—	26	197	-61.7	—	26	179	-59.8	—	29	164	-58.6	17	169	-60.0	—	29	170	-62.4	—	27	169	-60.9	—	—
13,000.....	15	165	-58.1	—	20	168	-62.6	—	26	152	-65.5	—	28	139	-59.4	16	144	-62.1	—	28	144	-63.1	—	26	144	-62.7	—	—
14,000.....	11	141	-59.8	—	16	122	-63.4	—	26	129	-69.9	—	28	119	-59.8	14	122	-64.0	—	28	123	-64.0	—	25	122	-64.2	—	—
15,000.....	6	120	-61.1	—	19	143	-62.6	—	25	109	-72.2	—	24	101	-60.2	13	104	-65.4	—	27	104	-65.3	—	24	104	-65.1	—	—
16,000.....	5	102	-61.9	—	15	104	-63.2	—	25	92	-72.3	—	18	86	-60.2	12	88	-65.7	—	24	88	-65.2	—	23	88	-65.0	—	—
17,000.....	—	—	—	—	13	88	-62.4	—	24	78	-71.6	—	10	73	-59.8	8	75	-65.0	—	23	75	-64.1	—	17	74	-64.0	—	—
18,000.....	—	—	—	—	15	75	-61.0	—	18	66	-69.4	—	—	—	—	10	64	-63.4	—	18	64	-62.6	—	6	63	-62.6	—	—
20,000.....	—	—	—	—	—	—	—	—	13	55	-65.6	—	—	—	—	—	—	—	—	8	54	-61.5	—	—	—	—	—	—
21,000.....	—	—	—	—	—	—	—	—	5	47	-63.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

TABLE 1a.—Mean free-air barometric pressures (P.) in mb., temperatures (T.) in ° C., and relative humidities (R. H.) in percent obtained by radiosondes during November 1939—Continued

Altitude (meters) m. s. l.	Stations and elevations in meters above sea level																											
	Omaha, Nebr. (300 m.)				Phoenix, Ariz. (339 m.)				St. Louis, Mo. (176 m.)				San Antonio, Tex. (174 m.)				Sault Ste. Marie, Mich. (221 m.)				Spokane, Wash. (597 m.)				Washington, D. C. ¹ (7 m.)			
	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.
Surface.....	30	989	2.7	66	29	977	13.4	61	30	1,005	4.9	71	29	1,004	11.6	71	30	995	-1.2	85	30	952	1.9	88	27	1,022	4.5	75
500.....	30	965	5.1	61	29	960	17.2	57	30	966	6.1	62	29	965	13.2	69	30	961	-1.9	86	30	906	5.8	70	27	962	4.2	57
1,000.....	30	908	5.2	53	29	905	16.8	49	30	908	4.1	60	29	910	11.0	71	30	902	-2.9	78	30	906	5.8	70	27	905	2.7	55
1,500.....	30	854	3.0	50	29	853	13.4	47	30	854	2.3	57	29	857	8.8	68	30	847	-3.2	65	30	852	5.3	60	27	851	1.5	51
2,000.....	30	802	1.1	46	29	803	9.6	48	30	802	0.5	54	29	806	6.9	64	30	795	-4.6	59	30	801	2.9	57	27	799	0.0	49
2,500.....	30	754	-1.3	42	29	756	6.4	49	30	754	-1.8	53	29	758	4.9	62	30	746	-6.8	57	30	753	0.2	57	27	750	-2.2	48
3,000.....	30	708	-3.9	41	29	711	3.4	48	30	708	-4.5	52	29	713	2.8	58	30	699	-9.1	57	30	707	-2.7	58	27	705	-4.3	49
4,000.....	30	623	-9.3	38	29	628	-3.0	44	30	623	-10.1	53	29	630	-1.3	48	30	614	-14.6	56	30	623	-8.5	55	27	620	-9.8	56
5,000.....	30	547	-15.9	36	28	552	-9.9	40	29	546	-16.6	50	29	555	-7.0	46	30	537	-21.1	56	28	547	-14.8	49	27	544	-15.8	56
6,000.....	30	478	-23.3	35	28	484	-17.7	40	29	477	-23.6	46	29	487	-13.4	45	30	469	-28.5	58	28	478	-21.7	46	26	476	-22.6	54
7,000.....	30	416	-30.8	35	28	423	-25.6	40	29	415	-31.8	43	29	426	-20.9	43	30	406	-36.3	57	28	416	-29.5	45	24	414	-29.7	56
8,000.....	30	360	-39.4	4	28	368	-33.4	40	29	359	-39.4	40	29	372	-28.2	43	28	351	-43.8	5	28	361	-37.5	45	19	359	-37.4	60
9,000.....	30	311	-46.8	—	28	318	-41.0	39	28	310	-46.5	—	29	322	-35.9	43	28	302	-51.0	—	28	312	-45.6	—	17	310	-44.7	—
10,000.....	30	267	-52.9	—	28	274	-48.0	—	28	266	-51.7	—	29	279	-43.2	—	24	258	-56.9	—	28	267	-53.2	—	16	267	-50.2	—
11,000.....	30	228	-56.4	—	28	235	-53.7	—	26	228	-55.7	—	29	240	-50.4	—	23	220	-59.6	—	28	229	-58.8	—	13	229	-54.7	—
12,000.....	29	184	-58.2	—	28	191	-57.8	—	26	184	-58.5	—	29	205	-56.9	—	21	188	-60.5	—	27	195	-61.7	—	11	195	-58.0	—
13,000.....	28	166	-59.2	—	28	171	-60.3	—	24	166	-59.6	—	29	175	-61.4	—	20	160	-60.5	—	27	186	-61.6	—	9	167	-60.1	—
14,000.....	26	141	-60.3	—	27	146	-62.3	—	23	141	-61.1	—	28	149	-64.5	—	16	136	-60.5	—	26	141	-60.9	—	—	—	—	—
15,000.....	26	120	-61.5	—	27	124	-64.5	—	20	120	-62.4	—	26	126	-66.8	—	12	116	-60.6	—	25	120	-60.9	—	—	—	—	—
16,000.....	20	102	-62.0	—	24	105	-66.0	—	18	102	-62.9	—	25	107	-68.2	—	8	98	-61.2	—	23	103	-61.0	—	—	—	—	—
17,000.....	9	87	-61.6	—	22	89	-66.6	—	10	87	-62.7	—	24	91	-68.6	—	—	—	—	—	22	87	-60.2	—	—	—	—	—
18,000.....	—	—	—	—	19	75	-65.6	—	—	—	—	—	19	76	-67.9	—	—	—	—	—	13	74	-69.0	—	—	—	—	—
19,000.....	—	—	—	—	16	64	-64.4	—	—	—	—	—	11	65	-66.5	—	—	—	—	—	6	64	-67.9	—	—	—	—	—
20,000.....	—	—	—	—	6	54	-63.3	—	—	—	—	—	7	55	-64.7	—	—	—	—	—	—	—	—	—	—	—	—	—

¹ U. S. Navy.

Observations taken about 1 a. m. 75th meridian time, except by Navy stations along the Pacific coast and Hawaii where they are taken at dawn.

NOTE.—None of the means included in this table are based on less than 15 surface or 5 standard-level observations.

Number of observations refers to pressure only as temperature and humidity data are missing for some observations at certain levels, also, the humidity data are not used in daily observations when the temperature is below -40° C.

LATE REPORT FOR JULY 1939

Altitude (meters) m. s. l.	San Antonio, Tex. (174 m.)				Altitude (meters) m. s. l.	San Antonio, Tex. (174 m.)			
	Number of obs.	P.	T.	R. H.		Number of obs.	P.	T.	R. H.
Surface.....	24	995	25.2	78	10,000.....	23	291	-32.3	37
500.....	24	958	24.5	79	11,000.....	23	252	-39.8	—
1,000.....	24	906	23.4	65	12,000.....	23	218	-47.3	—
1,500.....	24	855	21.7	58	13,000.....	23	187	-54.5	—
2,000.....	24	806	19.0	56	14,000.....	23	160	-60.9	—
2,500.....	24	761	15.9	54	15,000.....	23	136	-66.3	—
3,000.....	24	718	12.8	53	16,000.....	23	115	-69.8	—
4,000.....	24	637	6.8	50	17,000.....	22	97	-70.4	—
5,000.....	24	563	0.8	47	18,000.....	22	82	-68.7	—
6,000.....	24	497	-4.7	43	19,000.....	21	69	-66.0	—
7,000.....	24	438	-10.9	41	20,000.....	17	59	-63.3	—
8,000.....	24	383	-17.7	39	21,000.....	11	50	-60.8	—
9,000.....	24	334	-24.7	38					

TABLE 2.—Free-air resultant winds based on pilot-balloon observations made near 5 p. m. (E. S. T.) during November 1939

[Directions given in degrees from North (N=360°, E=90°, S=180°, W=270°)—Velocities in meters per second (superior figures indicate number of observations)]

Altitude (meters) m. s. l.	Abilene, Tex. (537 m.)		Albuquerque, que, N. Mex. (1,554 m.)		Atlanta, Ga. (302 m.)		Billings, Mont. (1,095 m.)		Boise, Idaho (850 m.)		Brooklyn, N. Y. (15 m.)		Brownsville, Tex. (7 m.)		Buffalo, N. Y. (220 m.)		Burlington, Vt. (132 m.)		Charleston, S. C. (18 m.)		Cheyenne, Wyo. (1,873 m.)		Chicago, Ill. (192 m.)		Cincinnati, Ohio (157 m.)				
	Di- rec- tion	Ve- loc- ity	Di- rec- tion	Ve- loc- ity	Di- rec- tion	Ve- loc- ity	Di- rec- tion	Ve- loc- ity	Di- rec- tion	Ve- loc- ity	Di- rec- tion	Ve- loc- ity	Di- rec- tion	Ve- loc- ity	Di- rec- tion	Ve- loc- ity	Di- rec- tion	Ve- loc- ity	Di- rec- tion	Ve- loc- ity	Di- rec- tion	Ve- loc- ity	Di- rec- tion	Ve- loc- ity	Di- rec- tion	Ve- loc- ity			
Surface	°		°		°		°		°		°		°		°		°		°		°		°		°		°		
500	314 ²⁰	0.6	201 ¹⁹	0.7	303 ²⁸	1.0	255 ²⁵	3.4	282 ²⁰	1.4	310 ²⁰	4.8	53 ²⁹	2.4	264 ²⁰	2.2	309 ²²	1.6	354 ²⁰	1.6	277 ²⁹	1.7	267 ²⁸	2.6	295 ²⁸	1.7			
1,000	57 ²⁰	0.2			302 ²⁸	1.0			289 ²⁰	1.2	306 ²⁰	5.3	51 ¹⁹	2.9	266 ²⁰	2.8	296 ²²	4.6	342 ²⁰	2.9			270 ²⁸	3.7	292 ²⁸	2.6			
1,500	283 ²⁰	0.7			323 ²⁷	3.0	261 ²¹	5.7	154 ¹⁹	1.2	312 ²⁰	5.5	41 ²⁷	2.0	273 ²⁰	5.9	292 ²²	6.3	336 ²⁷	3.2			282 ²⁶	6.6	297 ²⁷	3.0			
2,000	283 ²⁰	2.4	168 ²⁰	1.0	297 ²⁷	3.8	274 ²⁰	6.6	179 ¹⁹	1.1	322 ²⁰	8.0	27 ²⁶	0.3	283 ²¹	7.0	292 ²²	7.1	323 ²⁵	4.0			287 ²⁵	9.2	315 ²⁷	4.6			
2,500	283 ²⁰	3.9	146 ²⁸	1.3	283 ²⁴	5.8	282 ²⁰	7.4	243 ²⁸	2.8	314 ²⁰	9.5	266 ¹⁹	2.5	317 ²³	4.5	305 ²²	9.0	301 ²²	6.7	292 ²⁸	3.4	296 ¹⁹	9.5	308 ²⁷	8.5			
3,000	279 ²⁴	5.2	224 ²⁷	0.5	285 ²³	7.1	282 ²⁰	8.4	235 ²⁵	2.7	302 ²²	10.9	287 ²⁴	3.3	337 ²⁰	2.6	323 ²⁰	8.2	283 ¹⁹	7.6	294 ²⁸	5.0	299 ¹⁹	10.0	306 ²⁷	11.3			
4,000	293 ²⁰	6.4	263 ²³	1.3	287 ¹⁹	9.8	280 ²⁸	8.6	251 ²³	3.3	305 ¹⁹	10.4	279 ²¹	7.3					278 ²⁴	7.4	301 ²⁷	6.3	309 ²⁰	14.2	306 ²⁷	12.1			
5,000	297 ¹⁹	7.2	311 ²⁰	3.0	276 ¹⁸	12.5	296 ²⁴	10.2	280 ²¹	5.0										303 ²⁸	7.1								
6,000	284 ¹⁷	8.5	314 ²⁰	4.7	280 ¹⁷	14.6	285 ²⁸	8.8												313 ²⁸	7.7								
8,000	284 ¹³	17.5			311 ¹⁹	5.4	276 ¹⁸	22.0	320 ²⁸	7.5										341 ²¹	8.3								
10,000			290 ¹⁷	10.4	277 ¹⁴	30.2	351 ¹⁷	7.0												339 ²⁰	9.4								
12,000			276 ¹⁴	17.3	267 ¹²	36.8														304 ¹⁴	9.2								
14,000																				295 ¹⁰	8.9								

TABLE 2.—Free-air resultant winds based on pilot-balloon observations made near 5 p. m. (E. S. T.) during November 1939—Continued

Altitude (meters) m. s. l.	El Paso, Tex. (1,196 m.)		Fargo, N. Dak. (283 m.)		Greens- boro, N. Car. (271 m.)		Havre, Mont. (766 m.)		Houston, Tex. (21 m.)		Huron, S. Dak. (393 m.)		Las Vegas, Nev. (570 m.)		Little Rock, Ark. (82 m.)		Medford Oreg. (410 m.)		Miami, Fla. (10 m.)		Minneap- olis, Minn. (261 m.)		Nash- ville, Tenn. (194 m.)		New Orleans, La. (19 m.)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Surface	66°	1.6	216°	2.5	320°	0.9	260°	3.7	33°	1.5	199°	1.8	74°	0.6	10°	1.3	10°	0.1	38°	3.5	245°	1.3	1°	1.6	14°	2.4
500			222°	3.1	333°	1.8	252°	6.8	63°	1.4	204°	1.8	51°	2.4	16°	2.6	343°	1.2	41°	7.3	241°	2.2	342°	1.3	55°	2.3
1,000			246°	5.1	298°	3.1	257°	10.1	41°	5.5	248°	3.6	60°	2.6	25°	2.9	137°	1.8	48°	7.0	266°	4.0	342°	1.1	19°	2.2
1,500	85°	2.4	269°	6.0	316°	4.4	271°	11.2	333°	3.2	274°	5.8	49°	2.6	343°	1.3	174°	2.6	43°	4.8	277°	5.9	290°	2.2	355°	1.5
2,000	115°	2.4	272°	7.3	305°	6.8	283°	10.6	312°	4.3	285°	7.1	60°	1.3	309°	1.7	200°	3.0	38°	2.6	275°	7.3	288°	4.9	313°	3.4
2,500	176°	1.5	276°	7.0	295°	8.1	281°	9.6	307°	6.6	287°	7.6	65°	1.3	295°	3.9	227°	3.7	296°	2.9	286°	7.0	299°	6.2	300°	5.6
3,000	186°	1.2	285°	8.0	299°	10.6	275°	8.2	301°	7.5	290°	7.7	71°	1.0	301°	5.8	251°	4.0	297°	6.3	293°	8.6	297°	7.6	291°	7.0
4,000	251°	2.7	280°	9.1	287°	11.9	288°	8.2	298°	9.6	297°	9.2	297°	1.7	302°	10.4	252°	5.4	274°	9.0	303°	8.4	297°	9.1	291°	7.0
5,000	290°	4.1	295°	8.6	292°	15.3	292°	11.5	292°	11.5	298°	11.1	317°	2.3	299°	14.2	249°	7.3	274°	14.6	308°	10.2	292°	11.0		
6,000	282°	6.0	308°	9.1	291°	16.6	293°	14.3	304°	12.0	351°	3.4	322°	7.5			258°	6.5			322°	8.2				
8,000	275°	16.5	317°	15.3	296°	21.0					320°	12.9	353°	3.7												
10,000			309°	10.6							320°	14.6	332°	7.5												
12,000			289°	13.1							294°	13.6	304°	11.1												
14,000											293°	13.3		12.6												
16,000														11.9												
18,000														8.9												

Altitude (meters) m. s. l.	Oakland, Calif. (8 m.)		Oklahoma City, Okla. (402 m.)		Omaha, Nebr. (306 m.)		Reno, Nev. (1,346 m.)		St. Louis, Mo. (170 m.)		Salt Lake City, Utah (1,294 m.)		San Diego, Calif. (15 m.)		San Juan, P. R. (16 m.)		Sault Ste. Marie, Mich. (198 m.)		Seattle, Wash. (14 m.)		Spokane, Wash. (603 m.)		Washing- ton, D. C. (10 m.)		Winslow, Ariz. (1,488 m.)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Surface	254°	2.6	327°	1.6	251°	1.4	353°	0.5	281°	1.1	309°	1.7	288°	3.1	81°	4.5	281°	1.9	204°	2.8	196°	1.1	305°	2.1	30°	1.1
500	190°	2.1	357°	1.3	260°	1.3	295°	1.7	295°	1.7	303°	1.6	303°	1.6	93°	5.6	291°	2.8	191°	5.3	191°	5.3	301°	3.4		
1,000	173°	1.3	87°	0.9	271°	2.7	273°	3.2	263°	3.2	112°	1.5	103°	2.7	103°	2.7	180°	3.7	191°	8.0	197°	2.3	303°	5.2		
1,500	312°	0.8	331°	1.3	282°	4.8	42°	0.4	278°	4.5	305°	1.7	93°	2.7	122°	2.8	293°	3.8	192°	7.9	215°	5.7	301°	8.8		
2,000	276°	0.3	288°	2.9	282°	6.6	158°	1.7	280°	6.9	290°	1.0	85°	3.0	110°	2.8	294°	4.5	198°	7.8	234°	7.3	301°	10.4	65°	1.9
2,500	328°	1.0	291°	4.2	294°	8.1	200°	2.0	291°	8.4	230°	1.5	75°	2.8	120°	2.5	298°	5.3	207°	7.8	239°	7.5	296°	11.2	118°	1.4
3,000	338°	2.0	306°	6.4	298°	9.2	228°	2.3	294°	10.4	242°	1.8	53°	0.4	111°	2.8	300°	7.1	220°	8.1	240°	9.0	291°	12.4	153°	1.4
4,000	313°	2.2	306°	8.1	306°	9.7	264°	2.9	307°	11.0	251°	2.7	275°	2.1	110°	1.7	211°	0.7	221°	9.4	256°	9.3	292°	12.9	0°	0
5,000	274°	2.2	317°	9.8	306°	11.1	284°	3.5			248°	3.4	288°	6.1	211°	0.7										
6,000	280°	4.0	315°	12.6	313°	14.2	290°	4.1	307°	11.0	303°	3.6	292°	10.6												
8,000			306°	15.6	314°	17.9	283°	5.1			321°	6.5														
10,000			292°	17.5	312°	18.2	288°	8.7																		
12,000					291°	18.9	290°	11.1																		
14,000					278°	14.7																				
16,000					282°	13.2																				
18,000																										

TABLE 3.—Maximum free air wind velocities (M. P. S.), for different sections of the United States based on pilot-balloon observations during November 1939

Section	Surface to 2,500 meters (m. s. l.)				Between 2,500 and 5,000 meters (m. s. l.)				Above 5,000 meters (m. s. l.)						
	Maximum velocity	Direction	Altitude (m.) m. s. l.	Date	Station	Maximum velocity	Direction	Altitude (m.) m. s. l.	Date	Station	Maximum velocity	Direction	Altitude (m.) m. s. l.	Date	Station
Northeast ¹	45.7	NW	2,360	9	Harrisburg, Pa.	45.2	NNW	4,990	14	Buffalo, N. Y.	55.0	E	6,180	20	Akron, Ohio
East Central ²	37.6	SW	1,690	10	Cincinnati, Ohio.....	45.8	NW	4,570	8	Louisville, Ky.	60.0	W	11,640	16	Greensboro, N. C.
Southeast ³	24.2	NE	810	3	Key West, Fla.	40.4	W	4,950	24	Atlanta, Ga.	68.2	W	13,500	13	Atlanta, Ga.
North Central ⁴	41.5	S	1,590	26	Rapid City, S. Dak.	41.6	NW	5,000	7	Huron, S. Dak.	66.4	WSW	21,030	27	Rapid City, S. Dak.
Central ⁵	41.3	SW	1,240	10	Indianapolis, Ind.	48.8	NW	5,000	8	Indianapolis, Ind.	64.0	WSW	10,400	10	Wichita, Kans.
South Central ⁶	28.9	SSW	1,390	9	Oklahoma City, Okla.	31.4	NW	5,000	24	Oklahoma City, Okla.	75.2	WNW	12,750	5	Abilene, Tex.
North east ⁷	45.2	W	1,940	10	Havre, Mont.	43.5	W	3,950	10	Butte, Mont.	44.0	NW	7,700	9	Billings, Mont.
West Central ⁸	22.7	NNE	760	28	Oakland, Calif.	33.7	WNW	3,220	7	Cheyenne, Wyo.	68.5	NNW	11,030	27	Redding, Calif.
Southwest ⁹	21.7	WSW	2,370	9	El Paso, Tex.	49.0	S	4,800	5	Las Vegas, Nev.	62.0	WNW	12,160	4	Albuquerque, N. Mex.

¹ Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, and northern Ohio.² Delaware, Maryland, Virginia, West Virginia, southern Ohio, Kentucky, eastern Tennessee, and North Carolina.³ South Carolina, Georgia, Florida, and Alabama.⁴ Michigan, Wisconsin, Minnesota, North Dakota, and South Dakota.⁵ Indiana, Illinois, Iowa, Nebraska, Kansas, and Missouri.⁶ Mississippi, Arkansas, Louisiana, Oklahoma, Texas (except El Paso), and western Tennessee.⁷ Montana, Idaho, Washington, and Oregon.⁸ Wyoming, Colorado, Utah, northern Nevada, and northern California.⁹ Southern California, southern Nevada, Arizona, New Mexico, and extreme west Texas.

TABLE 4.—Mean altitudes and temperatures of significant points identifiable as tropopause during November 1939, classified according to the potential temperatures (10-degree intervals between 290° and 409° A.) with which they are identified. (Based on radiosonde observations)

Potential temperatures, ° A	Albuquerque, N. Mex.			Atlanta, Ga.			Billings, Mont.			Bismarck, N. Dak.			Boise, Idaho			Buffalo, N. Y.			Charleston, S. C.		
	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature
			°C.			°C.			°C.			°C.			°C.			°C.			°C.
290-299	1	8.2	-45.0	1	7.8	-41.0	1	9.2	-49.4	5	7.5	-38.4	3	7.4	-38.3	13	8.0	-35.3			
300-309	15	8.2	-45.0	10	8.0	-39.0	12	9.2	-49.4	27	9.2	-50.5	27	9.2	-49.5	24	7.3	-40.1	11	8.1	-38.4
310-319	31	9.0	-42.2	25	9.8	-48.6	35	10.7	-57.3	32	10.5	-56.9	35	10.9	-58.3	27	9.3	-52.5	15	9.3	-41.9
320-329	15	11.7	-58.4	20	11.3	-55.8	13	12.3	-64.6	12	11.7	-62.6	19	11.9	-63.4	11	11.5	-61.2	21	11.2	-53.0
330-339	15	12.2	-59.6	14	12.3	-59.7	4	12.6	-65.8	5	12.5	-63.2	12	12.5	-64.6	3	12.3	-61.7	12	12.3	-58.8
340-349	15	13.0	-60.9	8	12.9	-59.8	4	13.2	-63.8	2	13.0	-61.5	13	13.1	-63.5	1	12.5	-66.0	2	13.6	-65.0
350-359	15	13.9	-63.1	13	14.1	-65.5	1	13.4	-59.0	1	13.5	-61.0	13	13.6	-61.5	1	12.7	-64.0	4	14.7	-70.0
360-369	15	14.8	-65.3	5	14.7	-65.4	1	13.6	-57.0	1	13.9	-62.0	1	14.5	-65.0	1	14.4	-64.0	7	14.7	-66.4
370-379	15	15.5	-67.0	5	15.5	-68.0							1	15.1	-65.0	2	15.3	-67.5	7	16.0	-70.6
380-389	15	15.9	-68.0	5	16.3	-69.2							1	15.9	-67.5	1	15.3	-61.0	3	16.3	-63.5
390-399	3	16.4	-66.7	5	16.5	-68.3	1	15.8	-61.0				5	15.9	-64.7				3	16.6	-65.7
400-409	3	16.4	-66.7	5	16.5	-68.3									-57.6						-55.1
Weighted means		11.8	-55.8		12.1	-56.9		10.9	-57.5		10.3	-55.2		11.2	-57.6		10.0	-53.4		12.0	-55.1
Mean potential temperature (weighted)	344.3			347.3			328.4			324.3			331.8			324.0			345.6		
Potential temperatures, ° A	Denver, Colo.			El Paso, Tex.			Ely, Nev.			Joliet, Ill.			Lakehurst, N. J.			Medford, Oreg.			Miami, Fla.		
	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature
			°C.			°C.			°C.			°C.			°C.			°C.			°C.
290-299				1	7.0	-33.0	1	8.5	-48.0	2	5.8	-30.0				2	5.5	-32.5			
300-309				7	7.4	-21.9	16	8.3	-39.8	6	7.9	-39.3	1	8.0	-44.0	9	7.6	-40.7			
310-319	19	8.9	-45.12	18	9.8	-45.8	31	10.3	-54.6	19	9.3	-52.8	14	9.2	-51.0	15	11.8	-60.8	13	10.9	-47.4
320-329	36	10.3	-53.2	23	11.6	-53.0	16	11.5	-59.1	22	10.5	-56.0	6	10.8	-59.0	36	10.7	-56.9	17	12.5	-58.0
330-339	18	11.7	-60.7	10	12.2	-58.5	7	12.5	-63.3	11	11.1	-57.3	4	11.6	-60.5	15	11.8	-60.8	18	13.9	-65.7
340-349	11	12.4	-61.0	10	12.5	-64.3	5	13.2	-63.9	3	12.1	-60.0	1	11.2	-52.0	3	12.9	-61.3	13	14.9	-69.5
350-359	3	13.12	-62.7	11	14.5	-67.8	5	13.6	-61.6	2	13.4	-67.0	4	13.7	-62.2	4	13.8	-63.0	12	15.8	-73.3
360-369	3	14.0	-63.0	8	15.2	-69.2	1	14.4	-61.0	3	14.0	-61.0	1	14.2	-61.0	2	14.8	-64.5	12	16.3	-73.0
370-379	1	14.8	-65.0	10	15.9	-70.3	3	15.3	-65.3	3	14.4	-60.0				3	15.0	-65.0	5	16.7	-73.4
380-389	3	15.8	-65.3	6	16.0	-67.2	5	15.6	-64.8	1	14.7	-58.0				3	16.0	-68.3	13	17.5	-73.4
390-399	3	16.12	-64.0	4	16.7	-68.2	4	16.3	-65.6	2	16.0	-64.5									
400-409	3	16.12	-64.0	4	16.7	-68.2	4	16.3	-65.6	2	16.0	-64.5									
Weighted means		11.2	-55.6		12.6	-58.6		11.4	-55.7		10.7	-54.8		9.6	-54.3		11.1	-56.3		13.3	-64.7
Mean potential temperature (weighted)	335.1			350.9			338.5			331.6			323.6			332.8			362.0		
Potential temperatures, ° A	Minneapolis, Minn.			Nashville, Tenn.			Oakland, Calif.			Oklahoma City, Okla.			Omaha, Nebr.			Phoenix, Ariz.			St. Louis, Mo.		
	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature
			°C.			°C.			°C.			°C.			°C.			°C.			°C.
290-299	1	6.4	-39.0	2	6.4	-33.0							7	7.8	-42.6				1	7.2	-45.0
300-309	7	7.8	-46.1	16	8.5	-42.5				22	8.3	-40.5	29	9.0	-49.12	12	8.1	-37.8	6	7.7	-43.5
310-319	35	9.3	-51.3	16	9.9	-49.8	11	8.3	-39.2	11	8.3	-40.5	31	10.3	-57.8	21	10.1	-51.2	17	9.1	-49.8
320-329	26	10.7	-59.3	13	11.0	-52.7	42	10.3	-53.0	31	10.2	-51.6	11	11.6	-60.9	31	10.1	-51.2	10	10.4	-55.8
330-339	8	11.7	-62.0	6	12.8	-64.3	24	11.8	-61.5	12	11.7	-59.1	6	11.3	-60.9	18	11.0	-53.8	13	11.8	-62.5
340-349	4	12.3	-63.0				9	12.8	-64.8	14	12.6	-62.4	11	12.6	-61.0	9	12.5	-61.6	13	11.6	-57.0
350-359				2	13.7	-61.0	3	13.1	-61.7	3	13.1	-63.0	13	13.4	-64.0	10	13.1	-60.3	12	12.8	-59.7
360-369				2	14.8	-65.5	3	13.8	-64.7	14	14.1	-65.2	1	13.0	-55.0	4	14.1	-63.2	5	14.3	-61.2
370-379	1	13.7	-59.0	4	15.4	-67.2	4	14.6	-64.0	5	14.7	-64.6	12	14.4	-64.5	4	14.6	-64.8	5	14.3	-62.0
380-389				1	15.2	-61.0	4	15.4	-67.9	5	15.3	-66.2	2	15.3	-70.5	2	15.3	-70.5	1	14.8	-66.0
390-399	1	15.8	-65.0	3	16.5	-66.0	6	16.1	-68.12	2	15.4	-64.0	3	15.4	-63.7	4	16.2	-68.0	1	15.9	-65.0
400-409	1	15.4	-62.0				2	16.7	-68.0	7	16.5	-66.7	2	16.2	-62.5	4	16.6	-67.8	2	16.4	-67.5
Weighted means		10.1	-55.2		10.9	-52.2		11.7	-57.3		12.0	-57.2		10.4	-54.8		12.0	-56.1		11.0	-56.0
Mean potential temperature (weighted)	322.8			337.0			339.0			345.8			328.6			346.4			332.8		

TABLE 4.—Mean altitudes and temperatures of significant points identifiable as tropopauses during November 1939, classified according to the potential temperatures (10-degree intervals between 290° and 409° A.) with which they are identified. (Based on radiosonde observations)—Continued

Potential temperatures, °A.	San Antonio, Tex.			Sault Ste. Marie, Mich.			Spokane, Wash.		
	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature
290-299			°C.	4	6.6	-43.8	1	6.7	-42.0
300-309				11	8.3	-51.2	1	7.8	-46.0
310-319				22	10.0	-58.9	14	9.4	-51.4
320-329	13	9.9	-46.5	16	10.9	-62.9	29	10.7	-57.6
330-339	21	11.3	-53.9	5	11.9	-64.0	13	11.7	-62.5
340-349	17	12.5	-60.1				5	12.5	-63.0
350-359	15	13.5	-63.7				3	13.2	-62.0
360-369	6	14.6	-68.2				2	13.8	-65.0
370-379	7	15.2	-68.3				2	13.6	-58.5
380-389	7	15.9	-69.4	1	13.6	-56.0	1	15.1	-63.0
390-399	5	16.5	-70.6	1	15.6	-67.0	1	15.4	-62.0
400-409	2	16.6	-66.0						
Weighted Means		12.9	-59.9		10.0	-58.1		11.2	-57.8
Mean potential temperature (weighted)		351.8			318.1			330.7	

RIVERS AND FLOODS

[River and Flood Division, MERRILL BERNARD in charge]

By BENNETT SWENSON

Drought conditions continued during November 1939, over most of the country and record low stages for the month were established at a number of stations. No floods were reported.

WEATHER ON THE ATLANTIC AND PACIFIC OCEANS

[The Marine Division, I. R. TANNHILL in charge]

NORTH ATLANTIC OCEAN, NOVEMBER 1939

By H. C. HUNTER

Atmospheric pressure.—Pressure averaged higher than normal over the west-central, south-central, and south-eastern portions, particularly the southeastern. It was lower than normal over the extreme northwestern area. From the parallel of 40°, north latitude, southward the pressure almost everywhere averaged higher during the second half of the month than it had during the first half.

The extremes of pressure noted in available vessel reports are 1,035.6 and 965.1 millibars (30.58 and 28.50 inches). The high mark was noted on the American steamship *Narbo*, during the forenoon of the 23d, near 46° N., 32½° W. Table 1 indicates a slightly higher reading on shore at Horta, occurring on the 24th. The low mark was noted on the American steamship *Lafayette*, at 6 p. m. of the 5th, near 55° N., 10° W.

TABLE 1.—Averages, departures, and extremes of atmospheric pressure (sea level) at selected stations for the North Atlantic Ocean and its shores, November 1939

Station	Average pressure	Departure	Highest	Date	Lowest	Date
	Millibars	Millibars	Millibars		Millibars	
Julianehaab, Greenland ¹	995.9	-5.1	1,016	14	967	4
Lisbon, Portugal ²	1,023.8	+6.5	1,034	16, 17	1,010	4
Horta, Azores	1,023.5	+3.2	1,036	24	1,010	6
Belle Isle, Newfoundland ¹	1,007.5	-6	1,033	22	983	7
Halifax, Nova Scotia	1,016.2	+1.9	1,032	4	999	1, 17
Nantucket	1,019.3	+1.7	1,034	4	996	1
Hatteras	1,021.7	+3.1	1,031	10	1,007	20
Turks Island	1,013.6	-2.0	1,019	16	1,006	4
Key West	1,017.6	+1.0	1,024	27	1,012	19
New Orleans	1,022.7	+3.4	1,034	27	1,012	18

¹ For 26 days.

² For 25 days.

NOTE.—All data based on a. m. observations only, with departures compiled from best available normals related to time of observation, except Hatteras, Key West, Nantucket, and New Orleans, which are 24-hour corrected means.

Cyclones and gales.—The North Atlantic seems to have been about as stormy as in an average November, but the first half was stormier than the second half, and the final 5 days appear to have been nearly free from important storms.

Two instances of winds of hurricane force were reported, the first by the Danish steamship *Nevada*, on the 12th, near 51° N., 36° W., and the second by the American steamship *Lafayette*, on the 15th, approximately at 40° N., 38° W. Winds almost as intense, namely, of force 11, were noted by three vessels during the first week of the month, two of these being over the eastern part of the ocean, while the third was over waters to southward of Newfoundland, in connection with the disturbance of tropical origin which is mentioned elsewhere in this issue. A fourth instance of force 11 wind was noted, not quite a week before the month ended, in the vicinity of Sable Island.

Tropical disturbance.—Elsewhere in this REVIEW appears an account of the disturbance which started within the Tropics, late in October, and advanced slowly at first, crossing eastern Cuba on November 4, then moved swiftly northeastward till at last the morning of November 8, when it was central to the eastward of Labrador.

Fog.—Remarkably few reports of fog have been received. No portion of the North Atlantic is indicated to have had fog on 4 or more days, but two 5° squares are known to have had some on 3 days each. The occurrences for one of these, at the southern tip of the Grand Banks, were on widely scattered dates, but all the dates were within the period 11th to 16th in the case of the other square, which was in the northwestern Gulf of Mexico, 25° to 30° N., 90° to 95° W.

No fog whatever was reported near the coast of North America between Nova Scotia and Cape Hatteras, where there usually is a little fog during November. The region of the Grand Banks seems to have had less than half the normal amount of November fog.